REMARKS

The present application was filed on February 10, 2004 with claims 1 through 22. Claims 1 through 22 are presently pending in the above-identified patent application.

In the Office Action, the Examiner objected to claim 18. Claims 1-4 and 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al. ("Optical Filter Architecture for Approximating Any 2x2 Unitary Matrix," Optics Letters, vol. 28, no. 17, April 1, 2003, pages 534-536) in view of MacFarlane et al. (United States Patent Number 6,687,461). Claims 5 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al, in view of MacFarlane et al as applied to claims 4 and 16 respectively above, and further in view of Applicant's Admitted Prior Art. Claims 7-10 and 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al, and in view of Eyal et al ("Design of Broad Band PMD Compensation Filters," IEEE Photonics Technology Letters, vol. 14, no. 8, August 2002, pages 1088-1090). Claims 11 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al. in view of Eyal et al. as applied to claims 7 and 18 respectively above, and further in view of Applicant's Admitted Prior Art. The Examiner has indicated that claims 6 and 12 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Formal Objections

Claim 18 was objected to because the phrase "adjusting step" should be "adjustment" for consistency.

Applicant maintains that the cited phrase "adjusting step" is consistent with the term "adjusted" and explicitly addresses the previous section 101 rejection by requiring that a *step* is performed by a device.

Section 103 Rejections

Independent claims 1 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of MacFarlane et al. With regards to claim 1, for example, the Examiner asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters (citing page 535, left column, first complete par.).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *least mean square algorithm*. The Examiner asserts, however, that MacFarlane et al. teach a system related to Madsen including optical filters for compensating for polarization mode dispersion having adjusted coefficients (col. 1, lines 28-53, col. 2, lines 51-65 and col. 5, lines 23-42). The Examiner further asserts that MacFarlane et al. teach that the filter coefficients can be adjusted using a variety of minimization algorithms including a least squares algorithm or an LMS algorithm (col. 19, lines 16-22).

Applicant notes that independent claims 1 and 13 require adjusting coefficients of said two-port all-pass filters using a *least mean square algorithm*. Support for this limitation can be found, for example, in FIGS. 5 and 6 and associated text wherein the cross-coupled box T, as defined in equation (1), defines a two-port network since the two channels are appropriately coupled. Applicant acknowledges that the use of the LMS algorithm for adapting FIR filters and/or *single-channel* all-pass filters is both well-known and straightforward. Applicant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of *two-port all-pass filters*. It is *not* known to adapt *two-port all-pass filters* using the LMS algorithm. Furthermore, the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*. Thus, a person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the LMS algorithm.

In the Response to Arguments section of the final Office Action, the Examiner asserts that Applicant has not provided any reasoning or evidence in support of the statement that the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*.

Applicant submits herewith a paper entitled "Adaptive Algorithms for Two-Port Allpass Compensation of Polarization Mode Dispersion" dated September 23, 2002 and authored by applicant. As described in the abstract, the cited paper describes the derivation of a Newton-type algorithm, for example, in the context of a two-port structure consisting of multiple cascades of allpass filters and directional couplers. Since the adaptation equations for FIR filters and/or *single-channel* all-pass filters are not applicable for adapting *two-port all-pass filters* using the LMS algorithm or the Newton algorithm, section III describes a derivation of the

equations that are applicable for adapting *two-port all-pass filters* using the LMS algorithm or the Newton algorithm. Applicant maintains that the derivation of the cited equations would not be obvious to a person of ordinary skill in the art.

In further support of Applicant's position that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of *two-port all-pass filters*, Applicant notes that, for most applications, a two-port all-pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and, due to the complexity of an implementation with *two-port all-pass filters*, would *not* be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*, the combination suggested by the Examiner *would not work.*

In the Response to Arguments section of the final Office Action, the Examiner asserts that the above argument is not persuasive because two-pass all-port filters are expressly disclosed by Madsen. Applicant maintains, however, that in light of Madsen and MacFarlane, a person of ordinary skill in the art would select an FIR filter due to the complexity of utilizing *two-port all-pass filters* and the fact that the combination suggested by the Examiner *would not work.*

Similarly, Applicant notes that independent claims 7 and 18 require adjusting coefficients of said two-port all-pass filters using a Newton algorithm. Support for this limitation can be found, for example, in FIGS. 5 and 6 and associated text wherein the cross-coupled box T, as defined in equation (1), defines a two-port network since the two channels are appropriately coupled. Applicant acknowledges that the use of the Newton algorithm for adapting FIR filters and/or *single-channel* all-pass filters is both well-known and straightforward. Applicant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of *two-port all-pass filters*. It is *not* known to adapt *two-port all-pass filters* using the Newton algorithm. Furthermore, the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*. Thus, a person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

In further support of Applicant's position that it would *not* have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of *two-port all-pass filters*, Applicant notes that for most applications, a two-port all-pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with *two-port all-pass filters*, would *not* be motivated to utilize a *two-port all-pass filter* in combination with a Newton algorithm in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*, the combination suggested by the Examiner *would not work*. Thus, a person of ordinary skill in the art would be motivated to utilize a FIR filter.

In the Response to Arguments section of the final Office Action, the Examiner asserts that McFarlane teaches that filtering is based on the need to compensate for three types of dispersion, including polarization dispersion, which is PMD (col. 1, lines 43-46). Applicant notes that the text cited by the Examiner describes a "need" recited in the Background section of McFarlane. There is *no* disclosure or suggestion that the invention of McFarlane fulfills this need. Contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is *no* disclosure or suggestion to *compensate for polarization mode dispersion*.

The Examiner also reiterates that Eyal teaches adjusting coefficients using a Newton algorithm since Eyal teaches "using a Newton algorithm to optimize variables in equations for producing optimized filter coefficients."

Contrary to the Examiner's assertion, Eyal does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preeeding discussion in the same paragraph.

In the Response to Arguments section of the final Office Action, the Examiner asserts that the optimization variables of Eyal are effectively filter coefficients for the compensating filter, regardless of Eyal's use of the term "coefficient" for other designations.

Applicant finds no rationale in apparently disregarding Eyal's teachings regarding the term "coefficient."

Applicant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Applicant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do *not* apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would not recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

Also, contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is no disclosure or suggestion to *compensate for polarization mode dispersion*.

Thus, MacFarlane et al. does not disclose or suggest the step of "reducing said polarization mode dispersion." In addition, MacFarlane et al. does not disclose or suggest that the polarization mode dispersion is reduced "using a cascade of two-port all-pass filters," and the Examiner has not alleged that MacFarlane et al. discusses all-pass filters.

In addition, again contrary to the Examiner's assertion, MacFarlane et al. does **not** teach that the filter coefficients can be adjusted using a variety of minimization algorithms including an LMS algorithm (citing col. 19, lines 16-22). *While the LMS algorithm is discussed at col. 19, lines 16-22, it is **not** in connection with the adjustment of filter coefficients*. Rather, the discussion at col. 19, lines 16-22 is directed to adjusting "the gains on an on-going basis (of a network traffic router) to minimize error correction coding related error rates" (lines 11-13). It is further noted that as "the gains are adjusted, the control signal values in the look-up tables are also preferably updated as well." *Id.* at lines 14-16. Applicant can find ***no*** disclosure or suggestion in MacFarlane et al. to adjust the ***coefficients of a filter*** (especially a two-port all-pass filter) using the LMS algorithm (and especially in the context of reducing polarization mode dispersion).

In the Response to Arguments section of the final Office Action, the Examiner asserts that the LMS disclosure is tied to adaptive signal processing algorithms for adjusting the filters to minimize errors, which includes those caused by PMD in light of col. 1, lines 43-46.

Applicant reiterates that the text cited by the Examiner describes a "need" recited in the Background section of McFarlane. There is *no* disclosure or suggestion that the disclosed LMS algorithm is in connection with the adjustment of filter coefficients.

Applicant has previously acknowledged that the use of the LMS algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Applicant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the LMS algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would not recognize how to adapt <u>*two-port*</u> *all-pass filters* using the LMS algorithm.

An Examiner must establish "an apparent reason to combine … known elements." *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner states that it would have been obvious to implement the LMS adaptation of MacFarlane et al. in the system of Madsen as an "engineering design choice" of another way to provide the minimization function. As discussed hereinafter, the use of the LMS algorithm in the manner suggested only by the present invention is more than a mere design choice. Again, any discussion of adaptation using the LMS algorithm is not in the context of adjusting the ***coefficients of a filter*** (especially a two-port all-pass filter in the context of reducing polarization mode dispersion).

In the Response to Arguments section of the final Office Action, the Examiner asserts that Applicant does not provide reasoning or evidence against the use of LMS over LS as a design choice. As noted above, the adaptation equations for FIR filters do *not* apply to the adaptation of a two-port all-pass filter. Moreover, a person of ordinary skill in the art would not recognize how to adapt <u>*two-port*</u> *all-pass filters* using the LMS algorithm. Thus, the use of the LMS algorithm in the manner suggested only by the present invention is not a mere design choice.

Applicant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of two-port all-pass filters; and adjusting coefficients of said two-port all-pass filters *using a least mean square algorithm.*

There is *no* suggestion in Madsen or in MacFarlane et al., alone or in combination, to adjust coefficients of a cascade of two-port all-pass filters *using a least mean square algorithm.*

In further support of Applicant's position that it would not have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters, Applicant notes that for most applications, an all-pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with a two-port all-pass filter, would not be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter, the combination suggested by the Examiner *would not work.*

The above-noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art ***teaches away*** from the present invention. The *KSR* Court discussed in some detail United States v. Adams, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." (KSR Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

In the Response to Arguments section of the Office Action, the Examiner notes, in regard to Applicant's argument that "the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter," that the rejected claims do not recite particular equations.

Applicant notes that the cited argument was presented to illustrate that the Examiner's proposed combination of references was *not* valid because the combination suggested by the Examiner *would not work.* Applicant's argument is valid regardless of whether the equations are recited in the claims.

Claims 7 and 18

Independent claims 7 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of Eyal et al. With regards to claims 7 and 18, the Examiner again asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters (citing page 535, left column, first complete paragraph).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *Newton algorithm*. The Examiner asserts, however, that various optimization algorithms are known and that Eyal et al. teach a system including optical filters for compensating for polarization mode dispersion having adjusted coefficients (page 1088) and that the filter coefficients are adjusted using a Newton algorithm (citing page 1089, end of first par. of right column).

Eyal et al., however, do not disclose or suggest that the polarization mode dispersion is reduced "using a cascade of two-port all-pass filters," and the Examiner has not alleged that Eyal et al. discusses all-pass filters.

In addition, contrary to the Examiner's assertion, Eyal et al. does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

Applicant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Applicant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter. Thus, a

person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

An Examiner must establish "an apparent reason to combine … known elements." *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner merely states that it would have been obvious to implement the Newton adaptation of Eyal et al. in the system of Madsen as an "engineering design choice" of another way to provide the minimization function. As discussed hereinafter, the use of the Newton algorithm in the manner suggested only by the present invention is more than a mere design choiee.

Applicant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of two-port all-pass filters; and adjusting coefficients of said two-port all-pass filters *using a Newton algorithm.*

There is *no* suggestion in Madsen or in Eyal et al., alone or in combination, to adjust coefficients of a cascade of two-port all-pass filters *using a Newton algorithm.*

In further support of Applicant's position that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters, Applicant notes that for most applications, an all-pass filter is not advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with a two-port all-pass filter, would not be motivated to utilize a two-port all-pass filter, in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter, the combination suggested by the Examiner *would not work.*

The above-noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art ***teaches away*** from the present invention. The *KSR* Court discussed in some detail United States v. Adams, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful

means of combining them is more likely to be nonobvious." (KSR Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

Applicant respectfully requests the withdrawal of the rejection of independent claims 1, 7, 13 and 18.

Dependent Claims

Claims 2-6, 8-12, 14-17 and 19-22 are dependent on independent claims 1, 7, 13 and 18, and are therefore patentably distinguished over Madsen, MacFarlane et al., Eyal et al. and Wang et al., alone or in any combination, because of their dependency from independent claims 1, 7, 13 and 18 for the reasons set forth above, as well as other elements these claims add in combination to their base claim.

The Examiner has already indicated that claims 6 and 12 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

All of the pending claims, i.e., claims 1-22, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner or the Appeal Board has any further suggestions for expediting allowance of this application, the Examiner and the Appeal Board are invited to contact the undersigned at the telephone number indicated below.

The attention of the Examiner to this matter is appreciated.

Respectfully submitted,

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